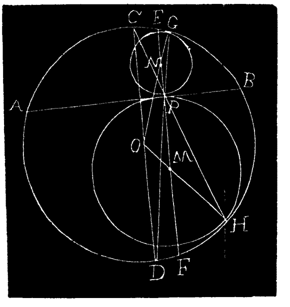
120. Proposed by P. C. CULLEN, Principal of Public Schools, Indianola, Neb.

Draw a circle tangent to a given circle and tangent to a given chord at a given point.

I. Solution by M. A. GRUBER, A. M., War Department, Washington, D. C.; G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.; and HENRY HEATON, A. M., Atlantic, Iowa.

Let O be the center of the given circle, and P the given point in the given chord AB.



Through P draw EF perpendicular to chord AB. Draw the diameter COD parallel to EF.

Through C and P draw line CH terminating at H in the circumference of the given circle.

Draw OH intersecting EF at M.

Then will M be the center of a circle tangent to chord AB at P, and tangent to the given circle at H.

Proof. The center of a circle tangent to AB at P must lie in the perpendicular EF.

The radii OH and MH are drawn to the point of tangency of the two circles. Therefore, the centers O and M and the point of tangency H must lie in the same straight line.

There remains to be proved $MP=MH$.

By construction, MP is parallel to OC, and $OC=OH$. Whence $\triangle COH$ and $\triangle PMH$ are similar.

$\therefore$ $MP=MH$, and M is the center of the required circle, MP and MH being radii thereof.

By a similar construction, we find N the center of a tangent circle on the other side of chord AB, the point of tangency being G.

II. Solution by J. OWEN MAHONEY, B. E., M. Sc., Professor of Mathematics and Science, Cooper Training School, Carthage, Tex.; JOHN J. QUINN, Instructor in Mathematics, Rochester Athenaum and Mechanics Institute, Rochester, N. Y.; GAYLOR CAMERON, Student Heidelberg University, Tiffin, Ohio; and P. S. BERG, B. Sc., Principal of Schools, Larimore, N. D.

Suppose the problem solved, and let O be the given circle, and E the center of the required circle, and C the given point. One locus of E is the perpendicular to AB at C. From C, on this perpendicular, take CD=radius of given circle; then $EO=ED$. Hence another locus of E is HE, the perpendicular bisector of OE. The intersection of HE and CD determines E.

III. Solution by the PROPOSER.

Let AOB be the given circle, AB the chord, and P the given point, C the center of given circle.

At P erect perpendicular, and with CB as radius construct circle MPN tangent to AB at P. Draw MN intersecting perpendicular at C, which is center of the required circle.

Excellent solutions were received from *J. W. YOUNG*, *J. SCHEFFER*, *ELMER SCHUYLER*, *CHAS. C. CROSS*, *WALTER H. DRANE*, *ALOIS F. KOVARIK*, and *P. H. PHILBRICK*.